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⑯ 発明の名称 流動層熱交換器

⑯ 特願 昭63-167499

⑯ 出願 昭63(1988)7月5日

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明細書

1. 発明の名称

流動層熱交換器

2. 特許請求の範囲

(1) 流動層熱交換器の外形を形成すると共に、その一側面側に空気を導入するための開口穴と、その他側面側に導入された空気を導出するための開口穴を有するケースと、

このケース内に配され、被熱交換流体が内部を流れる複数本のチューブと、

前記ケース内であって、前記チューブの外周囲に配される複数個の粒子と、

前記ケース内であって、前記ケースの一側面側から他側面側に向けて延び、前記ケース内において、

前記空気の通過方向と垂直方向に並ぶと共に、上下方向に積層される流動室に区画する仕切板とを備えることを特徴とする流動層熱交換器。

(2) 前記ケースの中心側に位置する流動室内には、前記ケース内壁側に位置する流動室内に比べ多くの粒子が封入されていることを特徴とする請求項1記載の流動層熱交換器。

(3) 前記空気流れに対して前記一側面側より上流側に設けられ、前記空気の案内路を形成すると共に、前記各流動室に送られる空気量を均一にする案内部材を備えることを特徴とする請求項1記載の流動層熱交換器。

(4) 前記ケースの一部は前記流動層熱交換器に向け空気を導入するダクトの一部より構成されることを特徴とする請求項1、2又は3記載の流動層熱交換器。

(5) 前記ケースの一側面側及び他側面側は複数の開口穴を有する網目状部材よりなることを特徴とする請求項1、2、3又は4記載の流動層熱交換器。

(6) 前記流動室は重力方向に対して、所定の角度をもって積層されることを特徴とする請求項1、2、3、4又は5記載の流動層熱交換器。

3. 発明の詳細な説明

流れに変える必要がある。

〔産業上の利用分野〕

本発明は流動層熱交換器に関し、特に自動車用空調装置のエバポレータに用いて有効である。

〔従来の技術〕

従来より、流動層を用いた熱交換器は粒子が風圧による浮遊と重力による落下により流動する特性を利用するものである。つまり、上下方向の空気の流れの中で使用するのが一番効率が良い。

従って、ほとんどの流動層熱交換器は下方から空気を供給し、上方に向けて排出している（特開昭59-4888号公報、特開昭60-114696号公報、特開昭62-33290号公報等）。

車両等においては取付けスペース、位置等の制約上、空気の流れが上下方向に通さないものが多く、第8図に示す様に横方向（矢印A）からの空気を、一旦流動層熱交換器100を通過する際、上下方向の流れに変え、再び横方向（矢印B）の

〔発明が解決しようとする課題〕

しかしながら、上記の様な構成ではダクト13内を通過する空気の流れが一方向だけないことや、空気がダクトに衝突した後、流動層熱交換器100を通過するため、空気の通風抵抗が大きく粒子が浮遊しにくいという問題があった。

また、第9図に示す様に、流動層熱交換器100を傾斜させて取付けた場合、粒子102が流動層熱交換器100の下方に沈滞し、空気が通過しても流動層熱交換器100の上方では粒子100がほとんど浮遊しない層が存在する。

つまり、従来の流動層熱交換器では車両等に熱交換器を傾斜させて取付けて用いる場合、粒子が均一に浮遊運動せず、十分に熱交換がされないという問題があった。

そこで本発明は横方向からの空気の流れに対してでも粒子を均一に浮遊運動させることにより熱交換効率を構成させ、また車両等への搭載性のすぐ

れた流動層熱交換器を提供することを目的とする。

〔課題を解決するための手段〕

本発明は流動層熱交換器を形成するケースの一側面側と他側面側との間を仕切板によって区画し、前記ケース内において、空気の通過方向を垂直方向に並び、上下方向に積層された流動室を形成する。

前記ケースの中心側に位置する流動室には、前記ケース内壁側に位置する流動室に比べ、多くの粒子が封入されている。

また、空気の流れに対してケースの一側面側より上流側に空気の案内路を形成し、各流動室に送られる空気量を均一にする案内部材を備える。

前記ケースの一部は前記流動層熱交換器に向け空気を導入するダクトの一部より構成される。

さらに前記ケースの一側面及び他側面は複数の開口穴を有する網目状部材よりなる。

前記流動室は重力方向に対して、所定の角度をもって積層されている。

〔作用〕

仕切板によって区画された各流動室に粒子が封入されているため、一部に粒子が沈滞することがなく、各流動室内で粒子が均一に浮遊運動する。

また、風速の速い流動室には多くの粒子が封入され、風速の比較的遅い流動室にはやや少なめに粒子が封入されているため、さらに各流動室内で粒子が均一に浮遊運動する。

また、空気の流れに対してケースの一側面側より上流側に空気の案内路を形成し、各流動室に送られる空気量を均一にする案内部材を備えているため、各流動室を通過する空気の風速分布が均一になり、各流動室内で粒子が均一に浮遊運動する。

〔発明の効果〕

以上のことにより、各流動室内で粒子が均一に浮遊運動するため、流動層熱交換器本体を傾斜させて取付けることができ、熱交換効率も向上する。

さらに、取付スペース・位置等の制約のある車両等においても、十分対応することができ、車両

搭載性にも優れている。

〔実施例〕

以下、本発明流動層熱交換器の一実施例を図面に基づき説明する。

第4図に示す様に、空気を導入する送風機10が送風機ケース11内に設けられている。送風機ケース11には外気導入口11a及び内気導入口11bが設けられ、さらに外気の導入もしくは内気の循環を切替える内外気切替ダンバ12が回動可能に設けられている。

送風機ケース11の開口部には通風ダクト13の一端が接続されている。そして、この通風ダクト13内には後述する流動層熱交換器（以下エバボレータと称す）100が設けられている。さらに通風ダクト13内にはヒータコア（省図示）、エアミックスダンバ（省図示）等が設けられ、空気の温度調節を行っている。

そして、通風ダクトの他端は、車室内への空気の吹出を行う各吹出口に向けて接続されている。

第1図及び第2図に示す様に、通風ダクト13内にエバボレータ100が設けられている。

このエバボレータ100は空気の主流の水平方向の流れ（矢印F）に対し、エバボレータ100の取付け、空気の流れ等を考慮して $\theta = 20 \sim 60^\circ$ 程度の傾きで設けられている。

ここで、エバボレータ100の構成を以下に示す。

偏平形状を有し、内部を冷媒が流れるチューブ101が平行に複数列、複数段設けられている。そして、これらのチューブ101は通風ダクト13を貫通し、通風ダクト外にて各チューブが夫々接続されている。

このチューブ101間にポリスチレンもしくはAl₂O₃からなり、直径が0.1～1mm程度の粒子102を封入する。そして、チューブ101の上流側に設けられ、粒子102の飛散及び落下を防止するアルミ製の網目形状を有する第1飛散防止板103とチューブ101の下流側に設けられ、粒子102の飛散を防止するアルミ製の網目形状

を有する第2飛散防止板104が設けられ、複数のチューブ101を囲む様に通風ダクト13に接続されている。ここで、第1飛散防止板103が、第2飛散防止板104、通風ダクト13によりケースが構成されている。

さらに、アルミからなる平板状の仕切板105の一端が第1飛散防止板103に他端が図中上段のチューブ101の下部101bにろう付等により接続され、アルミからなる平板状の仕切板106の一端が第2飛散防止板104に、他端が図中上段のチューブ101の上部101aにろう付等により接続されている。

これらの仕切板105及び106により第1飛散防止板103と第2飛散防止板104との間が区画され、複数の流動室107が形成されている。この流動室107は夫々が独立した部屋となっており、各流動室107にはほぼ同一量の粒子102が封入されており、粒子102は各独立した流動室107内でのみ浮遊運動する。よって、エバボレータ100の下方部に粒子102が集まり沈

滞することはなくなる。

尚、粒子102の層の高さは粒子が活発に流動し、熱交換効率が良好になるようにエバボレータ100を傾斜させた状態で落下防止板104から3mm以上とする。また、各仕切板の間隔は粒子が均一に流動するように粒子102の直径の10倍以上離して設ける。

また、第3図に示す様に第1飛散防止板103及び第2飛散防止板104は通風ダクト13の内周に設けられた断面長方形形状の固定溝13aに挿入されている。そして、突部13bより図示しないボルト等を嵌め込むことにより、第1飛散防止板103及び第2飛散防止板104を通風ダクト13に接続固定する。

次に、作動について説明する。

送風機10が作動すると、内外気切替ダンバ12の位置により空気を循環もしくは外気を導入し、内気もしくは外気がエバボレータ100を通過する。

このとき、チューブ101内を冷媒が流れ、粒

子102が各流動室107内で流動する。そして、空気とチューブ101外壁とが熱交換を行う。さらに、粒子102が流動することにより、粒子102がチューブ101外壁に衝突し、粒子102とチューブ101外壁とが熱交換したり、粒子102が空気とチューブ101外壁との温度境界層を破壊することにより、熱交換が促進される。そして、このエバボレータ100を通過して冷却された空気は適度な温度に調節され、車室内に導かれる。

第5図に粒子102を有さない単相流エバボレータの場合と、粒子102を有したエバボレータで仕切板無と仕切板有の場合の風速と熱交換量を比較したデータを示す。

仕切板105及び106有の場合、風速が1m/sを越えると熱交換量は減少するが、通常の最適な風速1m/s付近では単相流に比べてはもちろんのこと、仕切板105及び106無の場合に比べ、2~3倍程度の熱交換量を得ることができる。

また、仕切板105及び106を設けることによ

り、第1飛散防止板103及び第2飛散防止板104のたわみを防止することができる。

次に、他の実施例について説明する。

さらに粒子102を均一に流動化するため、第6図に示す様に風速分布（図中矢印Wは空気の相対的速度を示す）を考慮し、風速の比較的速い位置にある中心側の流動室107aの粒子量を風速の比較的遅い通風ダクト13内壁側の位置にある流動室107bの粒子量に比べ、多くする。

よって、風速の違いにより各流動室107内に倒入する粒子量を変えているため、各流動室107内の粒子102はさらに均一に流動する。

つまり、エバボレータ100の熱交換効率は向上し、エバボレータ100内を通過する空気は均一に冷却される。

その他の構成・作動は一実施例と同様である。

また、粒子102の均一な流動化を得るために、第7図に示す様に、第1飛散防止板103の上流側にアルミからなる平板状の案内部材である案内板14を仕切板105の直下に第1飛散防止板1

03を間に介してろう付等により接続する。

この案内板14は、風速の比較的速い中央付近では各案内板14の間隔の狭い空気の案内路Bを形成し、風速の比較的遅い通風ダクト13の近傍では通風ダクト13と案内板14の間隔の広い案内路Aを形成する。

よって、各流動室107に同程度の風量を供給することができるため、各流動室107内で粒子102が均一に流動する。つまり、エバボレータ100の熱交換率は向上し、エバボレータ100内を通過する空気は均一に冷却される。

その他の構成・作動は一実施例と同様である。

尚、本発明では流動層熱交換器をエバボレータに用いたが、ラジエーター、ヒータコア等にも用いることができる。

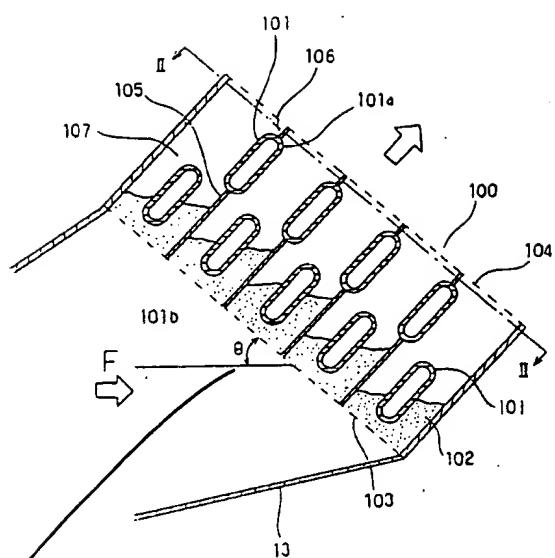
4. 図面の簡単な説明

第1図は本発明の一実施例を示す流動層熱交換器の断面図、第2図は第1図のII-II断面図、第3図はダクトと第1の部材及び第2の部材との接

続部を示す要部拡大図、第4図は従来の一例を示す流動層熱交換器の流動状態図、第5図は本発明の一実施と従来の一例の風速の熱交換量の関係を示す風速-熱交換量線図、第6図は本発明の他の実施例を示す流動層熱交換器の断面図、第7図は本発明の更に他の実施例を示す流動層熱交換器の断面図、第8図は従来の一例を用いた自動車用空調装置を示す模式図、第9図は従来の一例を示す流動層熱交換器の流動状態図である。

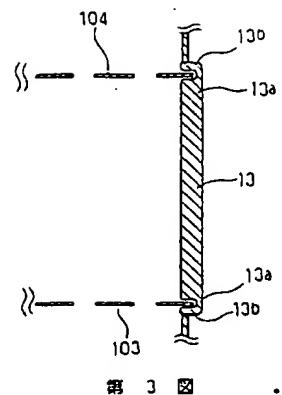
13…ダクト、14…案内部材、100…流動層熱交換器、101…チューブ、102…粒子、104…一侧面側、104…他側面側、105、106…仕切板、107…流動室。

代理人弁理士 岡 部 隆

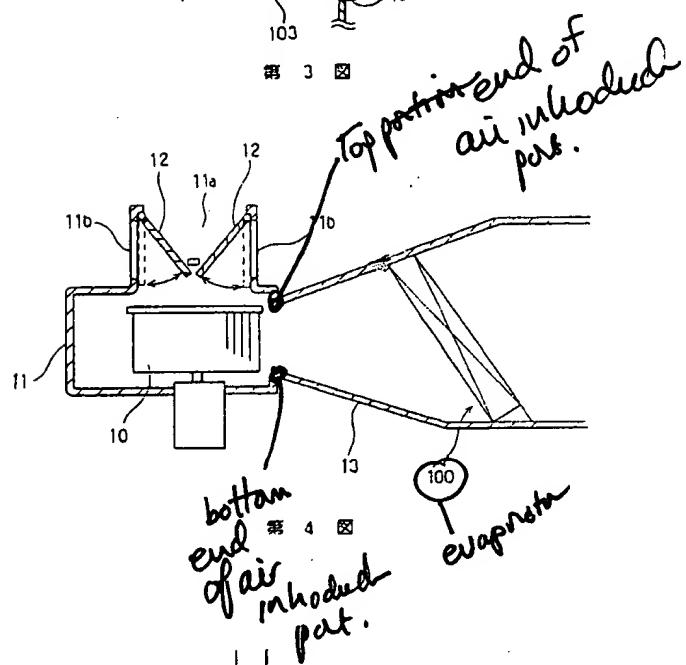


13 ... フレクト (ケ-ズ)
 100 ... 流動着熱交換器
 101 ... チューブ
 102 ... 管子
 103 ... 侧面側 (ケ-ズ)
 104 ... 他側面側 (ケ-ズ)
 105, 106 ... 仕切
 107 ... 流動室

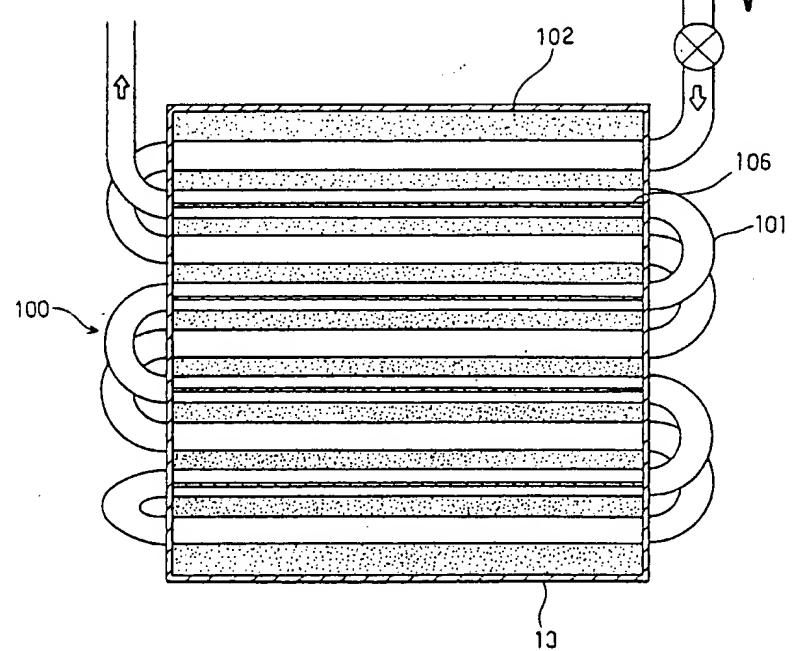
第 1 図



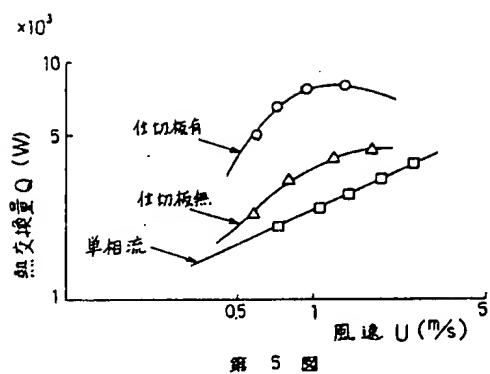
第 3 図



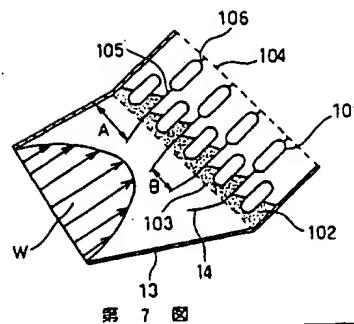
第 4 図



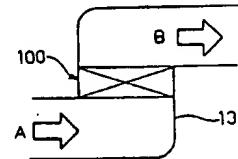
第 2 図



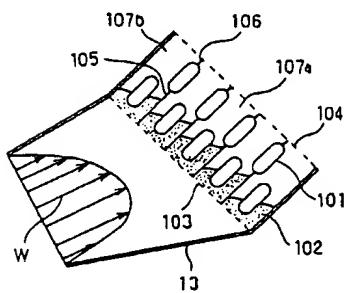
第 5 図



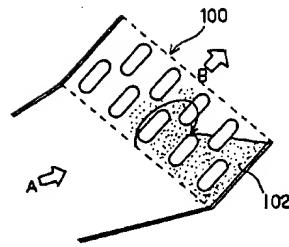
第 7 図



第 8 図



第 9 図



第 9 図

CLIPPEDIMAGE= JP402017388A

PAT-NO: JP402017388A

DOCUMENT-IDENTIFIER: JP 02017388 A

TITLE: FLUIDIZED BED HEAT EXCHANGER

PUBN-DATE: January 22, 1990

INVENTOR-INFORMATION:

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COUNTRY

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NIPPON DENSO CO LTD

APPL-NO: JP63167499

APPL-DATE: July 5, 1988

INT-CL (IPC): F28D013/00

US-CL-CURRENT: 165/166,165/170

ABSTRACT:

PURPOSE: To make uniform levitating motion of particles in a fluidized chamber, improve thermal efficiency and permit the slanted mounting of a main body by providing partitioning plates, arranged orthogonally to the passing direction of air and defining the title heat exchanger into the fluidized chambers laminated in up-and-down direction.

CONSTITUTION: An evaporator 100 is provided in a ventilating duct 13. A space between dispersion preventing plates 103, 104 is divided by partitioning plates 105, 106 to form a plurality of fluidized chambers 107. Particles 102 effect levitating motions in only respective independent fluidized chambers 107. Accordingly, the particles will never be collected and stagnated below the evaporator 100. Refrigerant flows into a tube 101 and heat exchange between air and the outer wall of the tube 101 is effected. A guide plate 104 provides a narrow guiding passage near the center of a heat exchanger, whereat an air speed is high, and provides a wide guiding passage at a part whereat the air speed is low. The particles perform uniform levitating motions

in such a
manner whereby the main body of the heat exchanger may be mounted
slantedly and
heat exchanging efficiency may be improved.

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SN 09/531,531

PTO 04-2293

Japanese Kokai Patent Application
No. Hei 2[1990]-17388

FLUIDIZED-BED HEAT EXCHANGER

Kazuo Nosaka, et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. MARCH 2004
TRANSLATED BY THE RALPH MCELROY TRANSLATION COMPANY

1

JAPANESE PATENT OFFICE
PATENT JOURNAL (A)
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No. of Claims: 6 (Total of 6 pages)

Examination Request: Not filed

FLUIDIZED-BED HEAT EXCHANGER

[Ryudosō netsu kokanki]

Inventors: Kazuo Nosaka, et al.

Applicant: NEC Corp.

[There are no amendments to this patent.]

Claims

1. A fluidized-bed heat exchanger characterized in that it is equipped with a case which forms the outside shape of the fluidized-bed heat exchanger while being provided with an opening on one side to introduce air and an opening on the other side to exhaust the air introduced, multiple tubes provided in said case in order for a fluidized-body from which heat is exchanged to flow therein, multiple particles placed at the periphery of the aforementioned tubes within the aforementioned case, and partitioning plates which extends from one side to the other of the aforementioned case within the aforementioned case

while being arranged perpendicularly to the direction the aforementioned air passes so as to partition vertically layered flow chambers within the aforementioned case.

2. The fluidized-bed heat exchanger described under Claim 1 characterized in that more particles are sealed in those flow chambers positioned in the center of the aforementioned case than in those flow chambers positioned on the inner walls of the aforementioned case.

3. The fluidized-bed heat exchanger described under Claim 1 characterized in that it is equipped with a guiding member which is provided on the upstream side of one of the aforementioned sides in terms of the aforementioned air flow so as to form a path for guiding a uniform amount of air into the aforementioned respective flow chambers.

4. The fluidized-bed heat exchanger described under Claim 1, 2, or 3 characterized in that a part of the aforementioned case is configured with a duct part used to introduce the air to the aforementioned fluidized-bed heat exchanger.

5. The fluidized-bed heat exchanger described under Claim 1, 2, 3, or 4 characterized in that the two sides of the aforementioned case are made of net-like members with multiple openings.

6. The fluidized-bed heat exchanger described under Claim 1, 2, 3, 4, or 5 characterized in that the aforementioned flow chambers are layered at a prescribed angle with respect to the direction of gravity.

Detailed explanation of the invention

Industrial application field

The present invention pertains to a fluidized-bed heat exchanger. It is particularly effective when used for an evaporator of an automobile air conditioning device.

Prior art

Conventional heat exchangers utilizing a fluidized-bed take advantage of the characteristic that particles moved as they are suspended by air pressure and dropped by gravity. That is, they can be utilized most efficiently in an air stream in the vertical direction.

Therefore, in most fluidized-bed heat exchangers, air is supplied from below and exhausted upward (Japanese Kokai Patent Application Nos. Sho 59[1984]-4888, Sho 60[1985]-114696, Sho 62[1987]-33290, and so forth).

In the case of a vehicle, due to restrictions in terms of installation space and position, the vertical air stream is often unsuitable. Thus, as shown in Figure 8, air supplied from a horizontal direction (arrow A) needs to be converted into a vertical air stream before it is put through the fluidized-bed heat exchanger and then back to a air stream in the horizontal direction.

Problems to be solved by the invention

However, because the air flow inside of duct 13 was not in one direction only, and the air passed through fluidized-bed heat exchanger 100 after it collided with the duct, the aforementioned configuration had a problem that the particles had difficulty becoming airborne due to high ventilation resistance of the air.

In addition, as shown in Figure 9, when fluidized-bed heat exchanger 100 was installed tilted, particles 102 stagnate at the bottom of fluidized-bed heat exchanger 100, so that a bed is created where hardly any particles 100 [sic; 102] become airborne at the upper part of fluidized-bed heat exchanger 100 even when the air passes through there.

That is, in the case of the conventional fluidized-bed heat exchanger, when the fluidized-bed heat exchanger is attached tilted to a vehicle, for example, the particles do not become airborne uniformly, resulting in a problem of insufficient heat exchange.

Accordingly, the purpose of the present invention is to present a fluidized-bed heat exchanger by which the particles can become airborne uniformly in response to a horizontal air flow in order to improve the heat exchange efficiency while achieving excellent mountability to a vehicle.

Means to solve the problems

In the present invention, [the space] between the two sides of a case which forms a fluidized-bed heat exchanger is partitioned using partitioning plates, and flow chambers which are layered vertically and arranged perpendicularly to the direction air flows are formed in the aforementioned case.

More particles are sealed in the flow chambers positioned in the center of the aforementioned case than in those flow chambers positioned on the inner walls of the aforementioned case.

In addition, it is equipped with a guiding member which is provided on the upstream side of one of the aforementioned sides of the case in terms of the air flow so as to form a path for guiding a uniform amount of air into the aforementioned respective flow chambers.

A part of the aforementioned case is configured with a duct part used to introduce the air to the aforementioned fluidized-bed heat exchanger.

Furthermore, the two sides of the aforementioned case are made of net-like members with multiple openings.

The aforementioned flow chambers are layered at a prescribed angle with respect to the direction of gravity.

Operation

Because the particles are sealed in the respective flow chambers partitioned by partitioning plates, local stagnation of the particle never takes place, and the particles become airborne and move uniformly within the respective flow chambers.

In addition, because more particles are sealed in those flow chambers with a relatively high air flow velocity, and slightly fewer particles are sealed in those flow chambers with a relatively low air flow velocity, the particles become airborne even more uniformly in the respective flow chambers.

In addition, because the guiding member is provided on the upstream side of one side of the case in terms of the air flow to form an air guiding path to send a uniform amount of air to the respective flow chambers, air flow velocity distribution of the air which passes through the respective flow chambers becomes uniform, so that the particles become airborne uniformly in the respective flow chambers.

Effect of the invention

Because the particles move uniformly in the respective flow chambers while they are suspended in the air in the manner described above, the main body of fluidized-bed heat exchanger can be attached tilted, and the heat exchange efficiency is also improved.

Furthermore, there are no problems with vehicles with restrictions in terms of installation space and position, offering excellent vehicle mountability.

Application examples

An application example of the fluidized-bed heat exchanger of the present invention will be explained below based on figures.

As shown in Figure 4, blower 10 for introducing air is provided in blower case 11. Blower case 11 is provided with outside-air introduction opening 11a and inside-air introduction opening 11b. Furthermore, inside/outside-air switching damper 12 is provided in such a manner that it can be pivoted.

Ventilation duct 13 is connected to an opening part created on one side of blower case 11. Then, fluidized-bed heat exchanger (will be referred to as an evaporator hereinafter) 100 is provided in said ventilation duct 13. Furthermore, a heater core (not illustrated) and an air-mixing damper (not illustrated) are provided in ventilation duct 13 in order to regulate the air temperature.

Then, the other end of the ventilation duct is connected to the vents used to send the air into the interior of the vehicle. As shown in Figures 1 and 2, evaporator 100 is provided inside of ventilation duct 13.

Evaporator 100 is attached at a tilt of $\theta = 20-60^\circ$ [sic; 60°] or so with respect to the direction the main stream of the air flows (arrow F) in the horizontal direction in consideration of the installation of evaporator 100 and the flow of the air.

Configuration of evaporator 100 will be shown below.

Flat tubes 101 for letting a coolant flow therein are provided in multiple parallel rows and in multiple stages. Then, these tubes 101 run through ventilation duct 13, and the respective tubes are connected to each other outside of the ventilation duct.

Particles 102 with a diameter of 0.1-1 mm or so made of polystyrene or Al_2O_3 are sealed between said tubes 101. Then, first aluminum net-like scattering prevention plate 103 placed at the upstream side of tubes 101 so as to prevent particles 102 from scattering and falling and second aluminum net-like scattering prevention plate 104 placed at the downstream side of tubes 101 so as to prevent particles 102 from scattering are provided, and they are connected to ventilation duct 13 in such a manner that they surround tubes 101. Here, the case is configured with first scattering prevention plate 103, second scattering prevention plate 104, and ventilation duct 13.

Furthermore, aluminum flat partition plates 105 are brazed to first scattering prevention plate 103 by one end while being brazed to lower parts 101b of tubes 101 in the upper stage in the figure by the other end, and aluminum flat partition plates 106 are brazed to second scattering prevention plate 104 by one end while being brazed to upper parts 101a of tubes 101 in the upper stage in the figure by the other end.

[The space] between first scattering prevention plate 103 and second scattering prevention plate 104 is partitioned by partition plates 105 and 106 so as to form multiple flow chambers 107. Said flow chambers 107 are formed as independent chambers, almost the same amount of particles 102 are sealed in each flow chamber 107, and particles 102 become airborne and move only inside of each independent flow chamber 107. Thus, particles 102 are never gathered to become stagnant at the bottom part of evaporator 100.

Furthermore, the height of particle 102 layer is 3 mm or more from fall prevention plate 104 when evaporator 100 is tilted in order for the particles to become airborne and move actively so as to achieve good heat exchange efficiency. In addition, the respective partition plates are provided at an interval 10 times as great as or greater than the diameter of particles 102 from one another in order for the particles to flow evenly.

In addition, as shown in Figure 3, first scattering prevention plate 103 and second scattering prevention plate 104 are inserted into fixation grooves 13a with a rectangular cross section provided on the inner periphery of ventilation duct 13. Then, first scattering prevention plate 103 and second scattering prevention plate 104 are connected and fixed to ventilation duct 13 by inserting bolts not illustrated inserted from protrusion parts 13b.

Next, its operation will be explained.

Once blower 10 begins operating, either [the interior] air is circulated, or outside air is introduced, and the interior air or the outside air goes through evaporator 100.

At this time, a coolant flows inside of tubes 101, and particles 102 flow inside of respective flow chambers 107, and the air and the outer walls of tubes 101 exchange heat. Furthermore, particles 102 collide with the outer walls of tubes 101 as particles 102 flow, and particles 102 and the outer walls of tubes 101 exchange heat. The heat exchange is further promoted as particles 102 break the temperature boundary layer between the air and the tubes 101. Then, the air being cooled as it passes through evaporator 100 is regulated to an appropriate temperature and introduced in the interior of the car.

Data on a comparison of the air flow velocities and the amounts of heat exchanged when a single-phase flow evaporator without particles 102, an evaporator with particles 102 but without any partition plates, and one with the partition plates are shown in Figure 5.

When partitioning plates 105 and 106 are involved, while the amount of heat exchanged is reduced once the air flow velocity exceeds 1 m/s, the amount of heat exchanges 2 to 3 times as much can be attained near the normal optimum air flow velocity of 1 m/s in comparison not only with the single phase flow but also with the case involving partition plates 105 and 106.

In addition, when partition plates 105 and 106 are provided, warpage of first scattering prevention plate 103 and second scattering prevention plate 104 can be prevented.

Next, another application example will be explained.

In order to allow particles 102 to flow even more uniformly, as shown in Figure 6, in consideration of air flow velocity distribution (arrow W in the figure indicates the relative velocity of the air), the amount of the particles put in flow chambers 107a provided in the center where the air flow velocity is relatively low is increased over the amount of the particles put in flow chambers 107b provided on the side of the inner wall of ventilation duct 13 where the air flow velocity is relatively low.

Here, because the amount of the particles to be seal in respective flow chambers 107 is changed according to the difference in the air flow velocity, particles 102 in respective flow chambers 107 flow even more evenly.

That is, the heat exchange efficiency of evaporator 100 is improved, and the air which passes through evaporator 100 is cooled uniformly.

Other configurations and the operation are identical to those of the application example.

In addition, in order to achieve uniform flow of particles 102, as shown in Figure 7, guiding plates 14, that is, flat plate-like aluminum guiding members, are connected through brazing just below partition plates 105 on the upstream side of first scattering prevention plates 103 via first scattering prevention plates 103.

Said guiding plates 14 form narrow air guiding path B between respective guiding plates 14 at a position near the center where the air flow velocity is relatively low, and wide air guiding path A between ventilation duct 13 and guiding plate 14 at a position near ventilation duct 13 where the air flow velocity is relatively low.

Thus, almost the same amount of air flow can be supplied to respective flow chambers 107, and particles 102 flow uniformly in respective flow chambers 107. That is, the heat exchange efficiency of evaporator is improved, and the air which passes through evaporator 100 is cooled uniformly.

Other configurations and the operation are identical to those of the application example.

Furthermore, although the fluidized-bed heat exchanger was utilized for an evaporator in the present invention, it can be utilized also for a radiator, a heater core, and so forth.

Brief description of the figures

Figure 1 is a cross-sectional view of the fluidized-bed heat exchanger of an application example of the present invention. Figure 2 is a cross-sectional view of Figure 1 along the II-II line. Figure 3 is an expanded view showing the part where the first member and the second member are connected. Figure 4 is a diagram showing the flow condition of the fluidized-bed heat exchanger of a conventional example. Figure 5 is a air flow velocity-heat exchange amount linear diagram showing the air flow velocity-heat exchange amount relationship between the application example of the present invention and a conventional example. Figure 6 is a cross-sectional view of the fluidized-bed heat exchanger of another application example of the present invention. Figure 7 is a cross-sectional view of the fluidized-bed heat exchanger of yet another application example of the present invention. Figure 8 is a schematic diagram showing an automobile air conditioning system which utilizes the conventional example. Figure 9 is a diagram showing the flow condition of the fluidized-bed heat exchanger of the conventional example.

13 ... duct; 14 ... guiding member; 100 ... fluidized-bed heat exchanger; 101 ... tube; 102 ... particle; 104 [sic.; 103] ... one side; 104 ... the other side; 105, 106 ... partition plate; and 107 flow chamber.

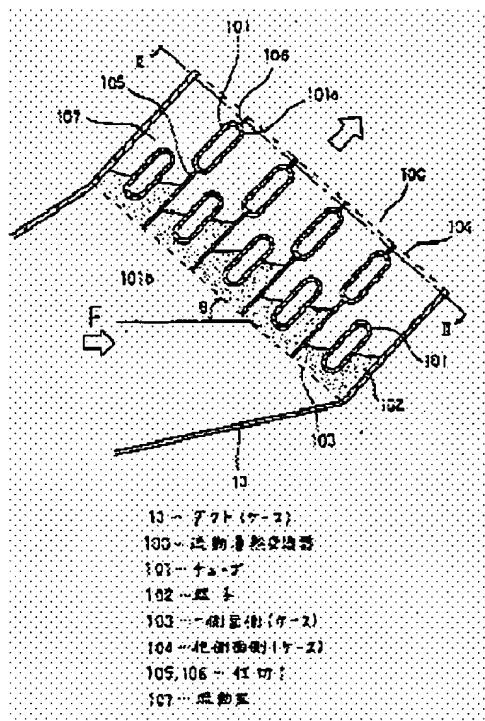


Figure 1

Legend:

- 13 Duct (case)
- 100 Fluidized-bed heat exchanger
- 101 Tube
- 102 Particle
- 103 One side (case)
- 104 The other side
- 105, 106 Partition plate
- 107 Flow chamber

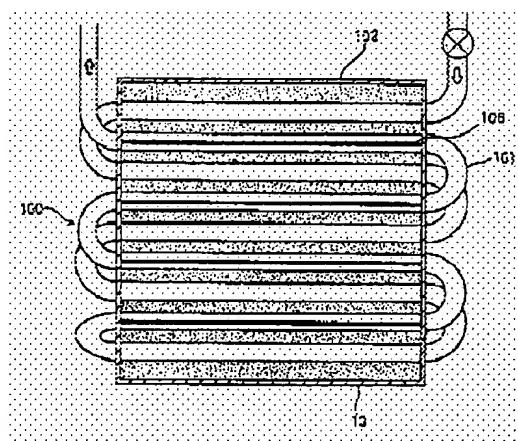


Figure2

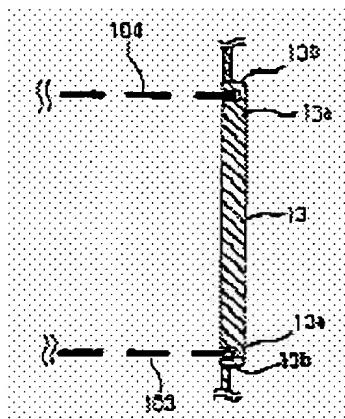


Figure 3

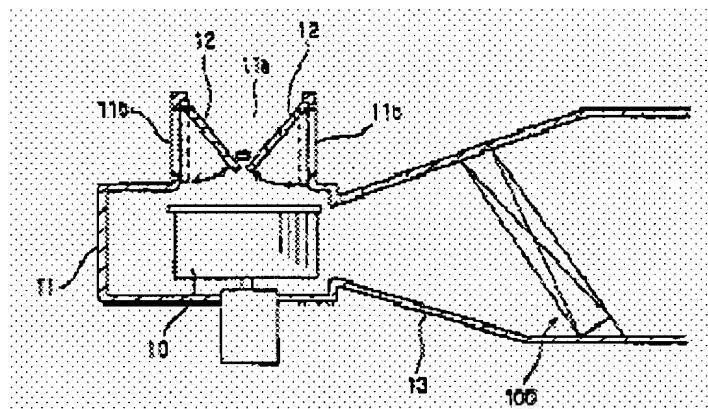


Figure 4

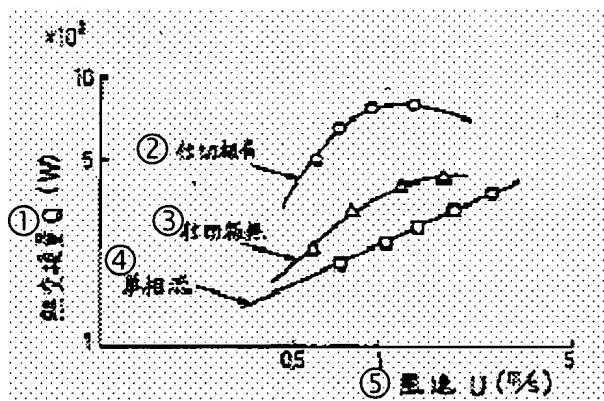


Figure 5

Key:

- 1 Amount of heat exchanged
- 2 Partition plate present
- 3 Partition plate absent
- 4 Single-phase flow
- 5 Air flow velocity

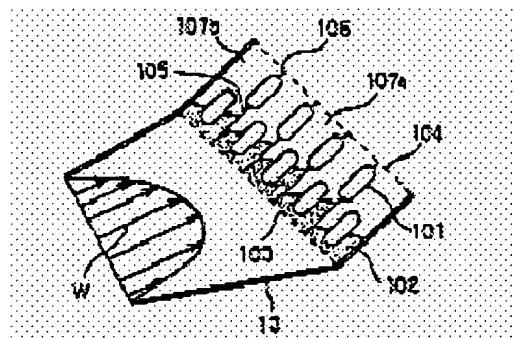


Figure 6

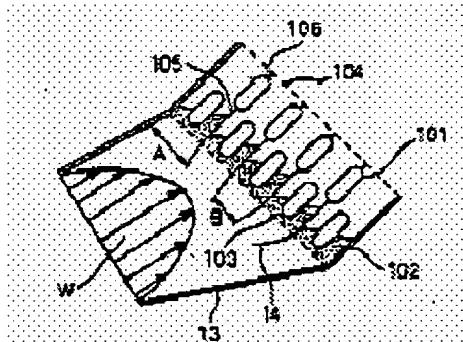


Figure 7

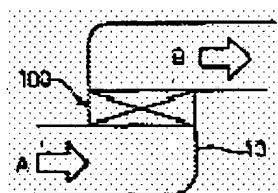


Figure 8

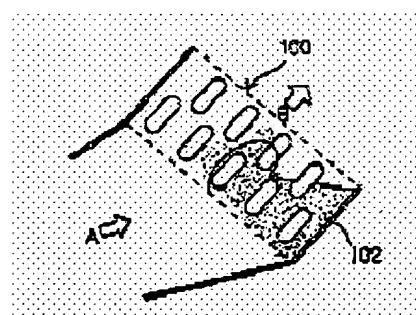


Figure 9